

WHAT IS CLAIMED IS:

1. A method for reducing the level of perchlorate load on perchlorate-loaded ion exchange resin comprising the steps of:
 - a. obtaining perchlorate-loaded ion exchange resin, and
 - b. directly contacting the perchlorate-loaded ion exchange resin with a perchlorate-destroying microorganism fluid product under conditions leading to conversion of perchlorate load on the resin to nonperchlorate reaction products and generation of treated ion exchange resin having reduced perchlorate load relative to the perchlorate-loaded ion exchange resin.
2. The method of claim 1 wherein the perchlorate-destroying microorganism fluid product is a fluid suspension comprising cultured perchlorate-destroying microorganisms.
3. The method of claim 1 wherein the perchlorate-destroying microorganism fluid product is a perchlorate-destroying microorganism culture supernatant liquid.
4. The method of claim 1 wherein the nonperchlorate reaction products comprise oxygen and at least one member of the group consisting of chloride, chlorite, hypochlorite and chlorate.
5. The method of claim 1 additionally comprising the step of
 - c. recovering the treated ion exchange resin.
6. The method of claim 5, wherein the method is a method for safely disposing of perchlorate-loaded ion exchange resin, said method additionally comprising the step of
 - d. disposing the recovered treated resin.

7. The method of claim 5, wherein the method is a method for regenerating perchlorate-loaded ion exchange resin, said method additionally comprising the step of

e. recycling the recovered treated ion exchange resin to a water treatment zone.

8. The method of claim 1, 6 or 7 wherein the conditions in step b. are anaerobic or facultative conditions.

9. The method of claim 8 wherein the perchlorate-destroying microorganism is selected from the group consisting of:

a mixed culture found in municipal anaerobic sludge,

a mixed culture found in activated sludge,

Vibrio dechloroticans Cuznesove,

strain GR-1

Wohanella succinogenes

Ideonella dechloratoms, and

Acinebacter thermotoleranticus.

10. The method of claim 5 wherein the recovering of step c. comprises rinsing the treated ion exchange resin.

11. The method of claim 5 wherein the recovering of step c. comprises sterilizing the treated ion exchange resin.

12. The method of claim 1 wherein the conditions in step b. include the presence of added substrate for the perchlorate-destroying microorganism.

13. The method of claim 12 wherein the added substrate is selected from lower alcohol, sugar or waste-activated sludge.
14. A method for removing perchlorate contamination from a perchlorate-containing feed water comprising
 - a. contacting the perchlorate-containing feed water with an anion exchange resin having an affinity for perchlorate thereby removing perchlorate from the feed water and forming a reduced perchlorate content product water and perchlorate-loaded ion exchange resin,
 - b. separating the reduced perchlorate content product water from the perchlorate-loaded ion exchange resin,
 - c. directly contacting the perchlorate-loaded ion exchange resin with a perchlorate-destroying microorganism fluid product under conditions leading to conversion of perchlorate load on the resin to nonperchlorate reaction products and generation of treated ion exchange resin having reduced perchlorate load relative to the perchlorate-loaded ion exchange resin
15. The method of claim 14 wherein the perchlorate-destroying microorganism fluid product is a fluid suspension comprising cultured perchlorate-destroying microorganisms.
16. The method of claim 14 wherein the perchlorate-destroying microorganism fluid product is a perchlorate-destroying microorganism culture supernatant liquid.
17. The method of claim 14 wherein the nonperchlorate reaction products comprise oxygen and at least one member of the group consisting of chloride, chlorite and hypochlorite.

18. The method of claim 14 additionally comprising the step of
 - d. recovering the treated ion exchange resin.
19. The method of claim 18 additionally comprising the step of
 - e. disposing the recovered treated resin.
20. The method of claim 18 additionally comprising the step of
 - f. recycling the recovered treated ion exchange resin to step a. for contact with perchlorate-containing feed water.
21. The method of claim 20 wherein the recovering of step d. comprises rinsing the treated ion exchange resin.
22. The method of claim 20 wherein the recovering of step d. comprises sterilizing the treated ion exchange resin.
23. The method of claim 14 wherein the conditions in step c. include the presence of nutrient for the perchlorate-destroying microorganism.
24. The method of claim 23 wherein the nutrient is selected from lower alcohol, sugar and carbon sources.
25. A method for removing perchlorate contamination from a perchlorate-containing feed water containing perchlorate and at least one of nitrate and sulfate comprising:
 - a. contacting the feed water with a first anion exchange resin having an affinity for perchlorate, nitrate and sulfate thereby removing perchlorate, nitrate and sulfate from the feed water and forming a reduced perchlorate, nitrate and sulfate content product water and perchlorate, nitrate and sulfate-loaded first ion exchange resin,

- b. separating the reduced perchlorate, nitrate and sulfate content product water from the perchlorate, nitrate and sulfate-loaded first ion exchange resin,
 - c. contacting the perchlorate, nitrate and sulfate-loaded first ion exchange resin with brine, under conditions leading to the displacement of the perchlorate, nitrate and sulfate ions off of the resin into the brine to yield a perchlorate, nitrate and sulfate-loaded spent brine and introduction of chloride ions onto the first ion exchange resin to yield a regenerated first resin,
 - d. separating the perchlorate, nitrate and sulfate-contaminated spent brine from the regenerated first resin,
 - e. contacting the separated spent brine with a second anion exchange resin having an affinity for perchlorate thereby removing perchlorate from the spent brine and forming a reduced perchlorate content treated spent brine and a perchlorate-loaded second ion exchange resin,
 - f. directly contacting the perchlorate-loaded second ion exchange resin with a perchlorate-destroying microorganism fluid product under conditions leading to conversion of perchlorate load on the resin to nonperchlorate reaction products and generation of treated ion exchange resin having reduced perchlorate load relative to the perchlorate-loaded ion exchange resin.

26. The method of claim 25 wherein the perchlorate-destroying microorganism fluid product is a fluid suspension comprising cultured perchlorate-destroying microorganisms.

27. The method of claim 25 wherein the perchlorate-destroying microorganism fluid product is a perchlorate-destroying microorganism culture supernatant liquid.

28. The method of claim 25 wherein the nonperchlorate reaction products comprise oxygen and at least one member of the group consisting of chloride, chlorite and hypochlorite.

29. The method of claim 25 additionally comprising the step of

g. discarding the treated spent brine.

30. The method of claim 25 additionally comprising the step of

h. recycling the recovered treated first ion exchange resin to step a. for contact with perchlorate-containing feed water.

31. A system for reducing the perchlorate load on a perchlorate-loaded anion exchange resin comprising

a first reaction zone containing a culture comprising a perchlorate-destroying microorganism strain, an aqueous medium, nutrient for the microorganism strain, said first reaction zone maintained at conditions promoting the growth of the perchlorate-destroying microorganism strain,

a second reaction zone containing perchlorate-loaded anion exchange resin,

means for recovering a perchlorate-destroying microorganism fluid product from the culture in the first reaction zone,

means for feeding the recovered perchlorate-destroying microorganism fluid product to the second reaction zone and contacting said fluid product with the perchlorate-loaded anion exchange resin, said second reaction zone being at conditions under which the perchlorate-destroying microorganism fluid product reacts with the perchlorate load present on the perchlorate-loaded anion exchange resin converting

perchlorate to non perchlorate reaction products thereby producing a reduced perchlorate-load anion exchange resin and

means for recovering the reduced perchlorate load anion exchange resin from the second reaction zone.

32. A system for reducing the perchlorate content of a perchlorate-contaminated water comprised a

a first reaction zone containing a culture comprising a perchlorate-destroying microorganism strain, an aqueous substrate, nutrient for the bacterial strain, said second reaction zone maintained at conditions promoting the growth of the perchlorate-destroying microorganism strain,

means for recovering a perchlorate-destroying microorganism fluid product from the culture in the first reaction zone

a second reaction zone containing an anion exchange resin having an affinity for perchlorate present in the perchlorate-contaminated water supply

means for feeding said perchlorate—contaminated water to said second reaction zone into contact with the anion exchange resin under conditions permitting the resin to remove perchlorate from the perchlorate-contaminated water thereby forming a reduced perchlorate content product water and perchlorate-loaded ion exchange resin,

means for separating the reduced perchlorate content product water from the perchlorate-loaded ion exchange resin,

means for contacting the perchlorate-loaded anion exchange resin formed in the second reaction zone with the perchlorate-destroying microorganism fluid product recovered from the first reaction zone said contacting being at conditions under which the perchlorate-destroying microorganism fluid product reacts with the perchlorate-load

present on the perchlorate-loaded anion exchange resin converting perchlorate to at least one of chloride, hypochlorite and chlorite thereby producing a reduced perchlorate-load anion exchange resin and

means for recovering the reduced perchlorate load anion exchange resin.

33. A system for reducing the perchlorate content of a perchlorate-contaminated water comprising a

a first reaction zone containing a culture comprising a perchlorate-destroying microorganism strain, an aqueous substrate, nutrient for the bacterial strain, said second reaction zone maintained at conditions promoting the growth of the perchlorate-destroying microorganism strain,

means for recovering a perchlorate-destroying microorganism fluid product from the culture in the first reaction zone

a second reaction zone containing an anion exchange resin having an affinity for perchlorate present in the perchlorate-contaminated water supply

means for feeding said perchlorate—contaminated water to said second reaction zone into contact with the anion exchange resin under conditions permitting the resin to remove perchlorate from the perchlorate-contaminated water thereby forming a reduced perchlorate content product water and perchlorate-loaded ion exchange resin,

means for separating the reduced perchlorate content product water from the perchlorate-loaded ion exchange resin;

means for contacting the perchlorate-loaded anion exchange resin formed in the second reaction zone with the perchlorate-destroying microorganism fluid product recovered from the first reaction zone said contacting being at conditions under which the perchlorate-destroying microorganism fluid product reacts with the perchlorate-load

present on the perchlorate-loaded anion exchange resin converting perchlorate to at least one of chloride, hypochlorite and chlorite thereby producing a reduced perchlorate-load anion exchange resin and

means for recovering the reduced perchlorate load anion exchange resin.

34. A system for reducing the perchlorate content of a perchlorate-contaminated water that additionally contains at least one of sulfate and nitrate comprising

a first reaction zone containing a culture comprising a perchlorate-destroying microorganism strain, an aqueous substrate, nutrient for the bacterial strain, said second reaction zone maintained at conditions promoting the growth of the perchlorate-destroying microorganism strain,

means for recovering a perchlorate-destroying microorganism fluid product from the culture in the first reaction zone,

a second reaction zone containing a first anion exchange resin having an affinity for perchlorate nitrate and sulfate present in the perchlorate-contaminated water supply

means for feeding said perchlorate-contaminated water to said second reaction zone into contact with the first anion exchange resin under conditions permitting the resin to remove perchlorate and any nitrate and sulfate from the perchlorate-contaminated water thereby forming a reduced perchlorate sulfate and nitrate content product water and perchlorate sulfate and nitrate-loaded ion exchange resin,

means for separating the reduced perchlorate sulfate and nitrate content product water from the perchlorate, nitrate and sulfate-loaded first ion exchange resin,

means for contacting the perchlorate-loaded first anion exchange resin formed in the second reaction zone with a salt brine under sulfate, nitrate and perchlorate displacing confections thereby forming a sulfate, nitrate and perchlorate-loaded spent brine, and a

reduced sulfate, nitrate and perchlorate-content regenerated first resin and means for separating the sulfate, nitrate and perchlorate-loaded brine from the regenerated first resin,

a third reaction zone containing a second anion exchange resin having enhanced affinity for perchlorate ion over nitrate and sulfate.

means for feeding the sulfate, nitrate and perchlorate loaded spent brine to said third reaction zone into contact with the second first anion exchange resin under conditions permitting the resin to preferentially remove perchlorate from the echolocate-contaminated spent brine thereby forming a reduced perchlorate content spent brine and perchlorate -loaded second ion exchange resin,

means for contacting the perchlorate -loaded second ion exchange resin formed in the third reaction zone with the perchlorate-destroying microorganism fluid product recovered from the first reaction zone said contacting being at conditions under which the perchlorate-destroying microorganism fluid product reacts with the perchlorate-load present on the perchlorate-loaded anion exchange resin converting perchlorate to at least one of chloride, hypochlorite and chlorite thereby producing a reduced perchlorate-load anion exchange resin and

means for recovering the reduced perchlorate load second anion exchange resin.

35. An ion exchange resin particularly designed to remove perchlorate contaminant from water comprising a solid, particulate, porous polymer structure carrying chemical moieties capable of associating with an anion and capable of exchanging that anion for perchlorate, said particulate porous structure having a film of perchlorate-destroying microorganisms adsorbed onto its surface.